Indo-Global Social Service Society

igsss

Representation of Urban Poor in Nagpur for Making Their Lives Climate Resilient

INDO GLOBAL SOCIAL SECURITY SOCIETY

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EXECUTIVE SUMMARY

The study proposed by Indo-Global Social Service Society (IGSSS) delves into the critical intersection of urbanization and climate change, with a particular focus on urban poor in the city of Nagpur in Maharashtra, India. Maharashtra, in particular, is one of the five most vulnerable states in the country. Nagpur, situated in a historically arid and semi-arid region is highly susceptible to climate risks. It is witnessing prolonged heat waves, flooding, and droughts which invariably have disproportionate effects on slum communities.

The "Research Study on challenges faced by urban poor/ informal workers due to extreme/ changing climatic events and identifying scope for community-based resilience building with low-cost solutions in 10 slums of Nagpur city" highlights the increasing vulnerability of urban areas to climate change and its adverse effects, especially on marginalized communities living in slums. Nagpur, known as the "Orange City," represents a microcosm of India's rapid urbanization and the complex challenges it poses.

The study found inadequacy of housing and habitat services and revealed common income sources through informal work such as domestic work, construction labour, street vending and so on. As a result, residents grapple with economic challenges stemming from limited access to adequate housing, basic services, and healthcare as the results presented here show.

The study further identified flooding and heatwaves as the primary climate stressors impacting livelihoods, leading to work disruptions, vector-borne diseases, and health issues.

To enhance community resilience, the report recommends three key intervention areas:

- Adequate Housing Infrastructure: Supporting the poor through affordable and adequate housing by leveraging government schemes and their own investments.
- Improved Access to Basic Services: Ensuring clean water, sanitation facilities, solid waste management, and road access to improve overall well-being.
- Delivering Healthcare: Providing accessible healthcare to address health challenges exacerbated by climate stressors.

INTRODUCTION

Climate change is known to have significant impacts globally on the frequency, duration, and intensity of extreme weather events, including heat waves. India, being a country in the tropical region is exposed to climatic risks and is vulnerable to climate change impacts on several sectors such as agriculture, forestry, health, and biodiversity. More specifically, the Indian subcontinent is experiencing higher temperatures that arrive earlier and stay for longer and will likely continue to experience more frequent heat waves in the coming decades.

The adverse impact of climate change in the form of decline in rainfall, sudden floods, frequent cyclones and rise in temperature has resulted in increased severity of livelihood issues in the country. Climate change represents additional stress on the ecological and socio- economic systems that are already under tremendous pressure due to rapid industrialization, urbanization, and economic development.

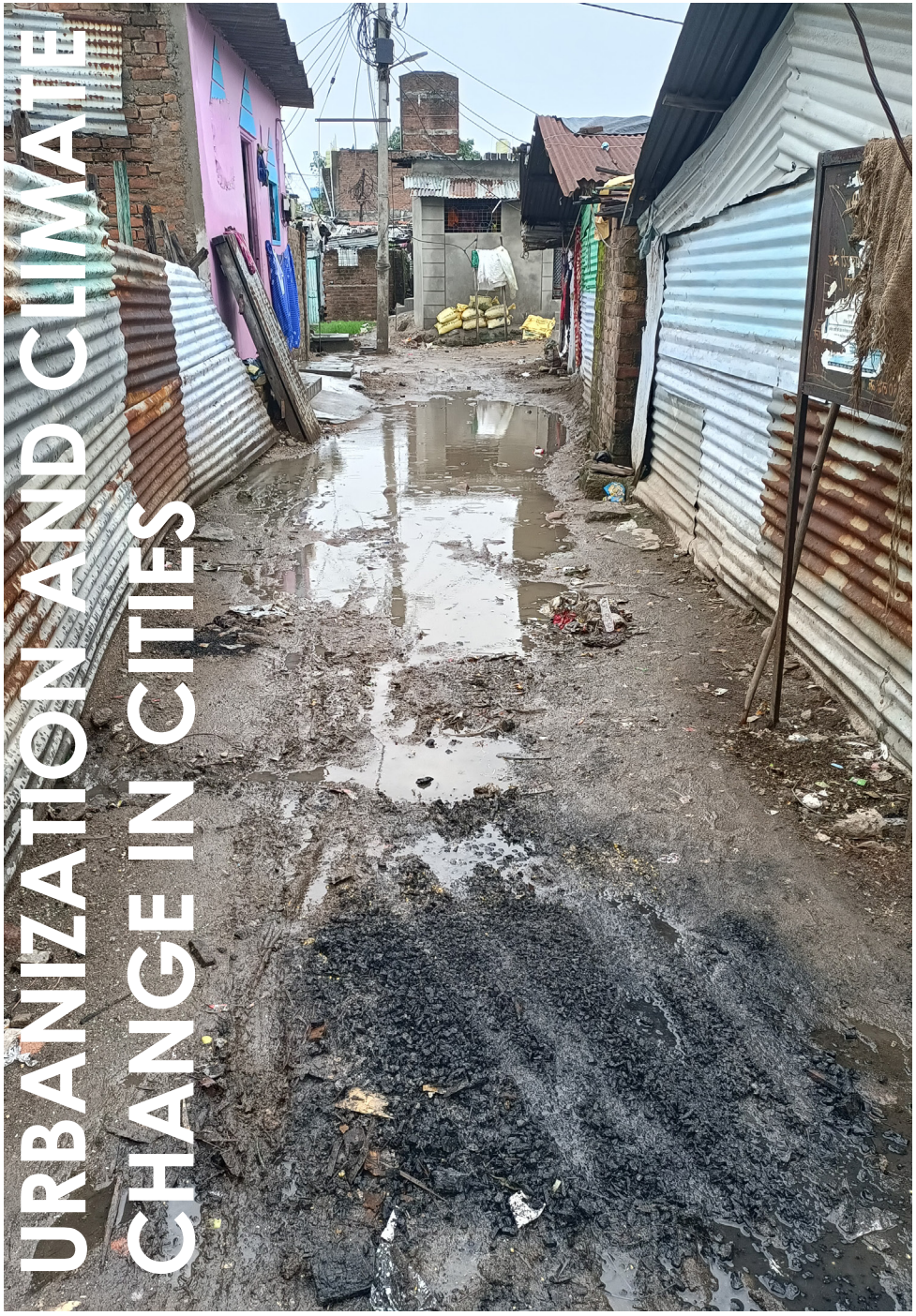
According to the Climate Vulnerability Index released by the Council on Energy, Environment and Water (CEEW), 2001, Maharashtra is one of the 5 most vulnerable states in India. Scientific analysis has revealed that there has been a six-fold increase in the frequency of extreme flood events in Maharashtra.

The state of Maharashtra and the geographical region of Vidarbha is historically one of the hardest hits by heat in the country, with heat waves prevailing in summer months. It is especially characterized by low and inconsistent rainfall, high air and soil temperature, exceptional sun-powered radiation, and high wind speed. The arid and semi-arid regions of the state experience high daily and occasional fluctuations in temperature. Midyear (March – July) temperature averages around a range of 26–46°C. With changes in climate, Nagpur is experiencing extreme weather events like never before.

The Satat Shehar programme of Indo Global Social Service Society (IGSSS) aims to support the urban poor community in slums of Nagpur to build resilience to climatic impacts and improve quality of life during extreme climatic shocks.

The Satat Shehar programme envisages an inclusive city that values all people and their needs equally. It is one in which all residents including the most marginalized and poor workers have a representative voice in governance, planning, and budgeting processes, and have access to sustainable livelihoods, legal housing, and affordable basic services such as water/sanitation and an electricity supply.

A systematic approach has been adopted by IGSSS to first conduct a Climate Audit in selected slums of Nagpur to understand the impacts of climate change on the lives and livelihoods of the poor and marginalized communities who are largely dependent on daily wage activities and climate resilient action plan. The key sectors selected for undertaking the climate audit include Infrastructure (Housing, Drinking Water Resources, Drainage, Solid Waste Management), Natural Resources (Natural water bodies, Biodiversity) and Health.



URBANIZATION AND CLIMATE CHANGE IN CITIES

India has seen tremendous urban progress. The population residing in urban areas in India, according to the 1901 census, was 11.4%, increasing to 28.53% by the 2001 census, and is now currently 34% in 2017 (Source: "Urban population (% of total) | data.worldbank.org.) It is estimated that by 2030, more than 400 million people i.e 40.76% of the country's population will be living in cities in India. (1)

India's urban areas make a major contribution to the country's economy, host a growing share of the population and are the main recipients of Foreign Direct Investment (FDI). India's cities have expanded rapidly as increasing numbers migrate to towns and cities in search of economic opportunity.

While bringing a range of economic benefits, such rapid urbanisation has brought with it enormous challenges, most noticeably in the form of demand-supply gaps in housing, infrastructure, and services. The pandemic has only deepened existing inequalities and reversed the success achieved in poverty reduction worldwide. The COVID-induced new poor in 2020 are estimated to be between 119 and 124 million.(2)

1. UN India, https://india.un.org/en/171267-poverty-and-urbanisation)
2. https://www.nmcnagpur.gov.in/demographic-profile

2.1
About Nagpur City

Nagpur, often referred to as the "Orange City," is a prominent city in the Indian state of Maharashtra. It boasts of a rich cultural, historical, and economic heritage. Nagpur is situated in the central part of the country. Nagpur is a significant transportation and logistics hub in the country and serves as an economic hub for the region, with a thriving industrial sector. It is known for manufacturing, trading, and transportation businesses. Nagpur is well-connected by road, rail, and air. It houses an international airport and is a crucial junction in the Indian railway network, making it a transit point for travelers.

Nagpur is spread over an area of 227.28 sq. km. with a population of 2.4 million. The majority of the land in Nagpur is developed for residential purposes (45%), followed by the land under public use (41%), as of 2011.

2.2
Nagpur Slums

Approximately 36% of the population lives in slums. There are 292 notified (legal) slums, and 135 non-notified (illegal) slums.(1) The inhabitants are mostly informal workers, seasonal small vendors, and housemaid servants. In addition, due to poor hygiene, poor sewage systems and irregular clearing of the garbage, diseases including malaria, cholera and abdominal problems are widely spread among the slum dwellers. 71% are in east Nagpur, while 29% are in the west part of the city.

"An estimated 8.08 lakh people are living in these slums."

According to the slum-mapping exercise, most people living in slums are migrants from the neighbouring states of Madhya Pradesh and Chhattisgarh.

The Nagpur Municipal Corporation is planning to regularize 427 slum areas that are on government land. 15 slum areas are on (Nagpur Municipal Corporation) NMC lands and 52 are on Nagpur Improvement Trust land. Around 60% of the slums are situated on Nazul land, a few on private land and many on reserved land for public utilities like playgrounds, parks etc.(2)

1. https://www.nmcnagpur.gov.in/demographic-profile
2. http://timesofindia.indiatimes.com/articleshow/67763553.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

2.3
Climate Risks in Nagpur

As per estimates from the National Research and Defence Council (NRDC), in 2013, Nagpur witnessed extreme temperatures for 21 days, which is double the duration of a typical heat wave. The NRDC report also states that Nagpur has seen temperatures exceed 45°C for seven consecutive summers. According to NMC estimates, in the last 10 years, 196 cases of sunstroke were recorded and 18 of these resulted in deaths due to heat-related complications. The temperature crossed all barriers and registered the lowest ever minimum temperature at 3.5 degrees Celsius on December 29, 2018 and the summer of 2019 recorded the highest maximum temperature at 47.5 degree Celsius on May 29. Nagpur typically witnesses water stagnation and flooding during monsoon rains and has witnessed few flash floods in the last decade. The city experienced the highest ever 24-hour rainfall on July 6 in 2018 with over 300 mm rains.

Another major climate hazard faced by Nagpur is drought. An assessment by the Indian Meteorological Department (IMD) highlighted that Nagpur witnessed 12 incidents of droughts between 1901 and 1998. However, the city is implementing several projects such as the 24*7 water supply project with new infrastructure, metered water supply with SCADA system to ensure equitable water supply across the city, reduction in leakages and thereby in NRW.

As per a Central Research Institute for Dryland Agriculture (CRIDA) report analysing historical data on frequency of hailstorm events across India in the last 38 years (1972–2011), Nagpur district witnessed the highest hailstorm events. However, in Nagpur urban area, the frequency of such events is very low.

2.4
Need for Climate Change Vulnerability Study

Extreme climate events, both within and outside of Nagpur, typically lead to socio-economic stress as well as impacts on health. As the impacts of climate change become increasingly evident, it is essential to understand the vulnerability of slum communities, and ecosystems to these changes.

The following are the challenges identified by NMC for Nagpur city. These issues further contribute to climate vulnerability due to their multiple interactions in association to livelihoods. These challenges are identified from an urban perspective. However, pro-poor issues such access to toilets and road infrastructure are not depicted.

Sectors	Sub-sectors	Key challenges	Climate Vulnerability
Housing	Potable Water	Nagpur faces non-revenue water (NRW) losses up to 50%, causing strain on the water supply system in terms of higher per capita supply than the set norms; illegal water connections; inadequate network and infrastructure etc.	Contamination of water can lead to public health risk.
	Solid Waste Management	- Segregation at source is a major issue in Nagpur.	Non-segregated waste dumping leads to generation of greenhouse gases, vector borne diseases and health impacts due to inhaling of toxic fumes.
		- Nagpur lacks a waste treatment plant or a scientific landfill. Approximately 1,100 - 1,200 TPD waste is disposed of at dumping yards, causing nuisance for surrounding areas.	
		- Lack of proper user charges' collection system for waste management services being provided by the urban local body (ULB).	
		- Insufficient scientific handling and treatment of bio-medical waste.	
	Sewage	- Only 65% wastewater is being treated due to inadequate sewerage network and aging infrastructure. Rest of the sewage flows directly to nullahs and rivers because of which the city's rivers are highly polluted, affecting allied ecosystems and services.	Pollution of natural ecosystems, increase in greenhouse gas emissions and health impacts
		- Risks and hazards from clogging of storm water drains due to solid waste dumping and mixing of sewage and storm water drains.	
	Stormwater Drainage	- Flooding of storm water drains in monsoon season due to inadequate stormwater drains coverage.	Localized flooding or greater runoff of contaminants such as trash, nutrients, sediment or bacteria into local waterways
		- Mixing sewage with storm water drains causes flooding of stormwater drains and creating unhealthy conditions.	
		- Heavy silting and blockage of storm water due to sewage mixing and solid waste disposal in open storm water drains.	
		- Polluted surface and groundwater due to direct discharge of sewage & storms into fresh water streams.	
Health	Public health	- The public healthcare facilities are not adequate and satisfactory.	Vector borne diseases and occurence of pandemic such as Covid-19
		- The condition of government run health/medical facilities has deteriorated significantly in the city.	
		- The urban poor are unable to access healthcare facilities in private hospitals.	
Natural Resources	Biodiversity	Due to the on-going urban development, Nagpur city is gradually losing its green cover. Ecosystems such as lakes are encroached and polluted.	Seasonal fluctuations and frequent temperature anomalies
	Natural water bodies	Nag River has been reduced to a heavily polluted stream carrying industrial waste, solid waste and sewerage.	More carbon absorption leading to loss of ecosystems and biodiversity along with health issues such as increase in waterborne diseases.

Above table can be accessed here : [Climate Resilient City Action Plan - Nagpur (Source: https://southasia.iclei.org/wp-content/uploads/2022/04/2.-Climate-Resilient-City-Action-Plan-Nagpur-Report-Low-Res_compressed.pdf)]

This vulnerability study is trying to identify the risk of urban slum communities as it is the first step to building climate resilient solutions. The study will also provide valuable insights into the risks posed by climate change and help policymakers, municipal corporations, and stakeholders make informed decisions to mitigate and adapt to its effects.

2.5
Scope of Study

This study was undertaken in the city of Nagpur in July - August 2023. 10 slums were selected as the sample size and 338 respondents participated in the survey study. the following slums were chosen:

Rahul Gandhi Nagar

Chikhali Quarter (Shitlamata Mandir)

Pili Nadi

Taj Nagar

Adivasiprakash Nagar

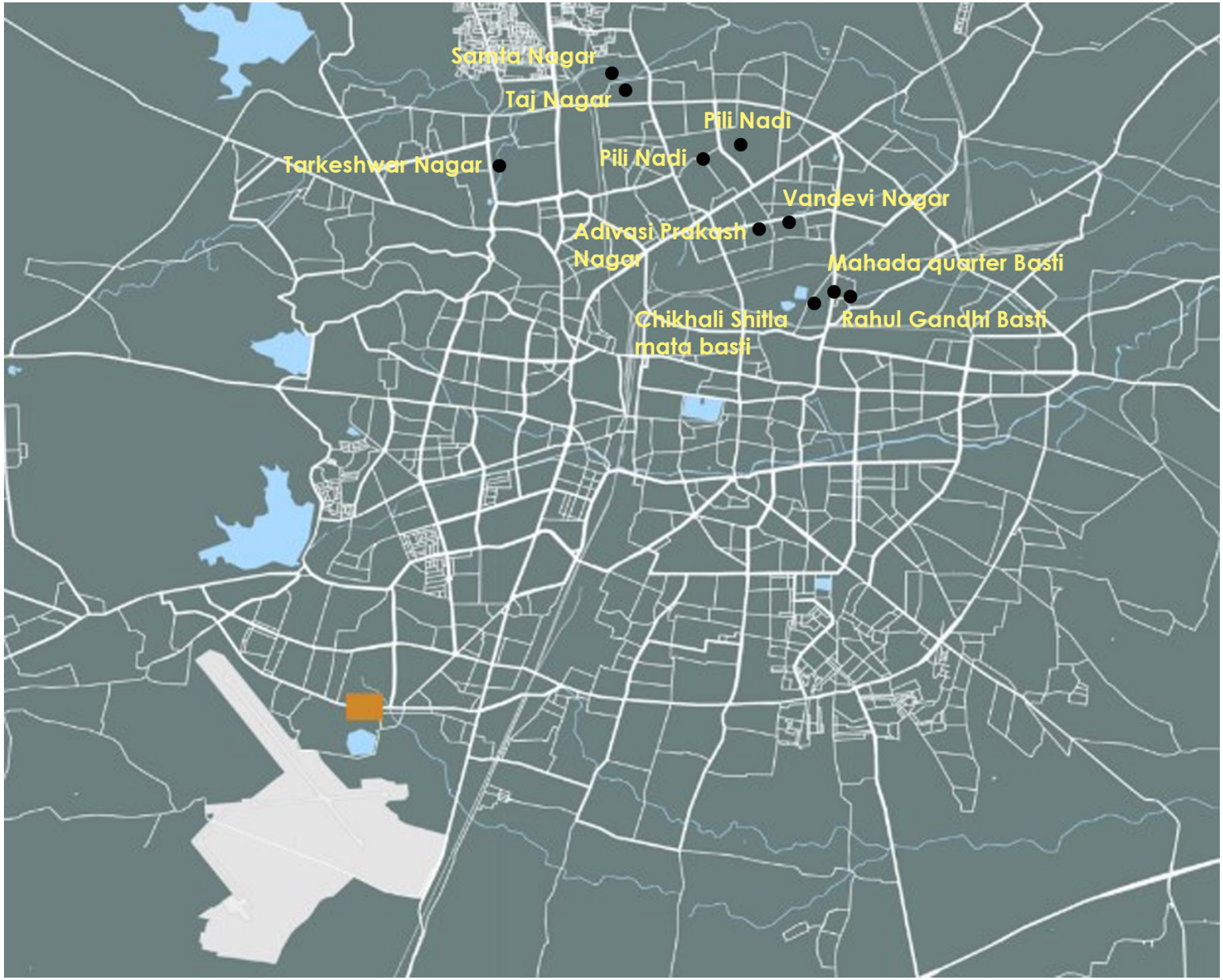
Samta Nagar

Shehensha Nagar

Tarkeshwar Nagar

Vandevi Nagar

Mahada Quarter


Samta Nagar
Taj Nagar
Pili Nadi
Pili Nadi
Tarkeshwar Nagar
Vandevi Nagar
Adivasi Prakash Nagar
Mahada quarter Basti
Chikhali Shitla mata basti
Rahul Gandhi Basti

2.6
Objectives of Study

- To understand the challenges and impact of climate change on urban poor communities (street vendors, domestic workers, waste pickers, construction workers etc.) in Nagpur city through qualitative and quantitative means.

- To identify the coping measures or any low-cost solutions and recommend them to improve the resilience and combat climate change impact on urban poor communities in Nagpur city.

2.7
Expected Outcomes from the Study

The expected outcomes from this climate change vulnerability study are multifaceted and can provide valuable insights to guide policy, planning, and mitigation efforts. These outcomes include:

- Identification of Vulnerable Areas: The study will pinpoint specific geographical regions and communities that are most vulnerable to climate change impacts.

- Risk Assessment: It will provide a comprehensive assessment of the risks associated with climate change, helping policymakers and stakeholders prioritize actions to reduce these risks.

- Improved Resilience Strategies: By understanding vulnerability, this study will suggest tailored resilience strategies that address the unique challenges faced by different regions and communities. These strategies will include infrastructure improvements, technological interventions, disaster preparedness plans, and action plans at city level.

- Socioeconomic Insights: The study will shed light on how climate change affects various socioeconomic factors, including income inequality, employment opportunities, and access to essential services.

- Policy Formulation: This study will help in planning and informed decision making for betterment of Nagpur city.

- Public Awareness and Education: The study's results can be used to raise public awareness about climate change risks and vulnerabilities, fostering a greater sense of urgency and responsibility among individuals of urban poor communities.

- Data for Future Planning: The data and information generated by the study can become a valuable resource for future research and project planning for the next phase. It can serve as a baseline for monitoring changes in vulnerability over time and assessing the effectiveness of adaptation measures.

- Informed Decision-Making: Ultimately, the study's outcomes empower decision-makers with the knowledge needed to make informed choices about climate change adaptation and mitigation strategies. This can lead to more effective and sustainable policies and actions.

- Funding Allocation: City level stakeholders, organizations, researchers can use the study's findings to allocate funding and resources to address vulnerability in areas with the greatest need.

METHODOLOGY

In undertaking the climate change vulnerability study in Nagpur slums, the methodology followed was as follows:

Secondary Research

Secondary literature review of documents such NMC's urban plans, NRDC's reports and Sectoral vulnerability reports.

Urban scenario and Climate Data Analysis

Gathering of relevant data related to urbanization in India, climate change, hazards, socio-economic indicators.

Climate Audit at Micro (Slum) level

Qualitative tools - collection of slum level information and data on the indicators to understand the climate-related vulnerabilities and exposures of the natural resources and communities/their livelihoods.

Devising climate resilience recommendations

Based on the surveyed vulnerabilities at the slum level, recommend climate resilience options

Data Analysis and Documentation

Draft Report on Climate vulnerabilities and recommend climate resilient options based on case studies around the country.

3.1
Qualitative and Quantitative Tools

Focus Group Discussions: Focus group discussion (FGD), in which a group of participants is guided by a moderator (or group facilitator) helps the group to participate in a lively and natural discussion amongst them, ultimately leading into a consensus. (Annexure 1)

Household Interviews: Key informant interviews are qualitative in- depth interviews with people who are well informed about the community. (Annexure 2)

Causal Analysis: To engage participants in a participatory manner to identify the causes and sub-causes of a problem and draw out actions for solving the problem.

3.2
Key Aspects Studied for assessing Climate Vulnerability

Based on the IGSSS's priority areas of climate interventions and taking into account the urban challenges identified by NMC, the key thematic areas were identified for assessing Climate change vulnerability and Resilience Plan building in 10 slums of Nagpur. The areas were:

- Housing: A home is much more than just a physical structure. It provides a household with security and is often the biggest financial investment a household will make. Secure and well-located shelter can be the foundation for a range of co-benefits, such as enhanced livelihoods and employment opportunities (especially for women), access to public services, and social cohesion. It is one of the most important aspects to climate resilience and inadequate housing can lead to climate risk vulnerability. Ensuring that housing infrastructure is resilient to climate change is a means to achieving more resilient societies.

- Potable water: Access to clean and safe water is a critical issue in slum areas due to limited infrastructure and inadequate resources. Slum dwellers often face challenges in obtaining a reliable and sanitary water supply. Many slum water sources are contaminated with sewage, chemicals, and pollutants, leading to waterborne diseases and health issues. Slum dwellers often have to travel long distances to access water sources, which can be time-consuming and physically demanding. Access to water can be particularly challenging during the summer season.

- Solid waste management: Effective waste management is crucial for maintaining a clean and healthy living environment for residents, preventing pollution, and reducing health risks. Lack of financial resources, institutional weakness, improper choice of technology and public apathy towards SWM have made this service far from satisfactory.

- Sewage management: Establishing a proper sewer network in slums is a significant challenge due to the densely populated and often informal nature of these settlements. However, improving sanitation through effective sewer systems is crucial for public health, environmental sustainability, and overall well-being.

- Access to toilet: Access to proper sanitation facilities, including toilets, is a significant challenge in slum areas. Lack of proper toilets can lead to poor hygiene, health issues, and a loss of dignity for slum dwellers. Improving sanitation facilities in slums is essential not only for the health and well-being of residents but also for the overall development and dignity of these communities. It requires a combination of infrastructure development, community involvement to create sustainable and effective solutions.

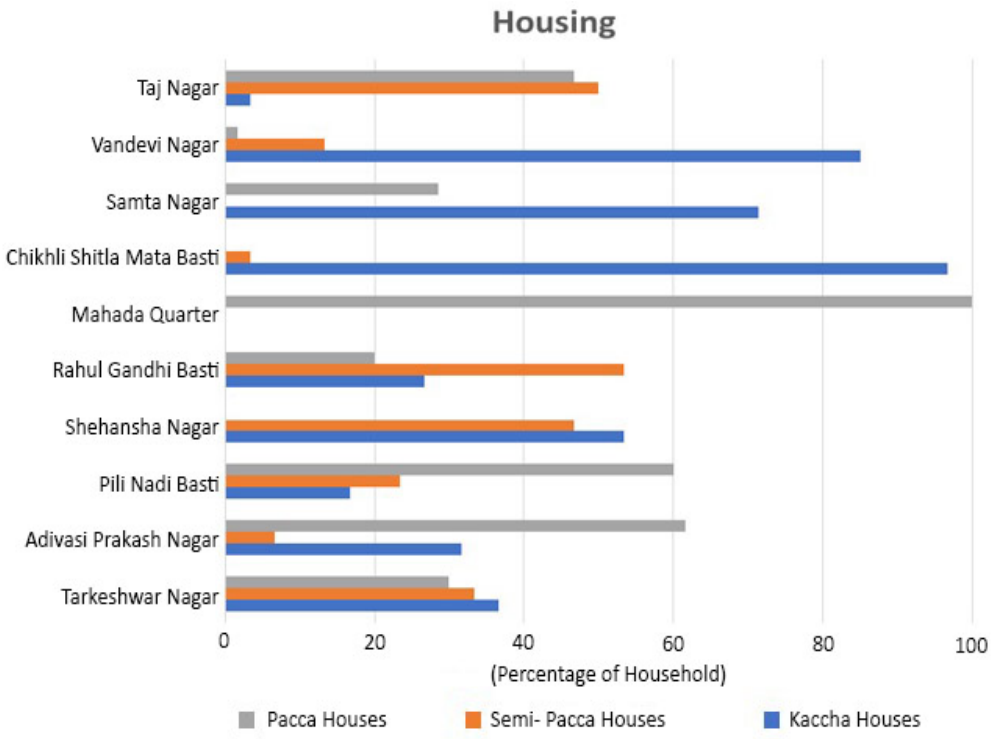
- Road infrastructure: The absence of proper roads in slum settlements is a pressing issue that significantly hampers the mobility, accessibility, and overall quality of life of residents. Roads are the lifeline of transportation networks, connecting communities and facilitating the delivery of goods and essential services. Yet, in many slum areas, this fundamental infrastructure is lacking, giving rise to a multitude of challenges and negative impacts on the lives of the dwellers.

- Health and Well-being: The health of the community is dependent upon the social, economic, political, and legal determinants that shape human health and well-being, especially in the poor communities in urban slums. It is one of the most important factors that determine the overall health of the city. It is also a means to better livelihood.

3.3
Study Findings

3.3.1 Housing

From the FGD and primary visit to slums, housing infrastructure was categorized into kuccha, semi-pucca and pucca houses as these types of houses exist in the slums.



Bar diagram of presence of kaccha, semi-pucca and pucca houses in slums.

Kaccha houses are constructed using tin shelters, wood planks, tarpaulin materials etc in slums. These are temporary shelters in nature, corrugated metal sheets and wood planks used for walls construction and for roof tarpaulin and metal sheets mostly used. They offer minimal protection from the elements but are affordable to construct. These materials are affordable but prone to various challenges and climate change vulnerabilities.

Metal roofs can become extremely hot under the sun, making the interior of the house unbearably warm during hot weather. This can lead to discomfort and increased energy consumption for cooling. In colder climates, these houses can become very cold due to poor insulation properties. This can result in discomfort.

During storms and lighting events these houses are not well-suited to withstand strong winds, as they can be easily damaged or even blown away in severe weather conditions. Metal sheet roofs can attract lighting strikes, posing a fire hazard.

It was also found that many houses were located below ground level or near water sources which were prone to waterlogging and sewage water inundation as compared to others. The plinth level of several homes was also seen as a problem due to which there was water seepage from the floor.

From the study it was found that Chikhli Shitla Mata Basti was the most vulnerable to climate risks with 97% houses being kaccha houses followed by Vandevi Nagar with 85% kachha houses and Samta Nagar with 77%.

Semi-pucca houses are built using a combination of materials such as bricks, concrete, corrugated metal sheets, and sometimes cement. These materials provide a higher level of stability compared to purely kaccha houses. This shows efforts to improve living standards in slum areas often focus on providing access to basic services, upgrading housing conditions, and ensuring the legal recognition of residents' tenure.

From the study, it was found that 8 slums had semi-pucca houses in various percentages. Rahul Gandhi basti had the highest semi-pucca houses with 53% followed by Taj Nagar with 50% and Shehensha Nagar with 47%.

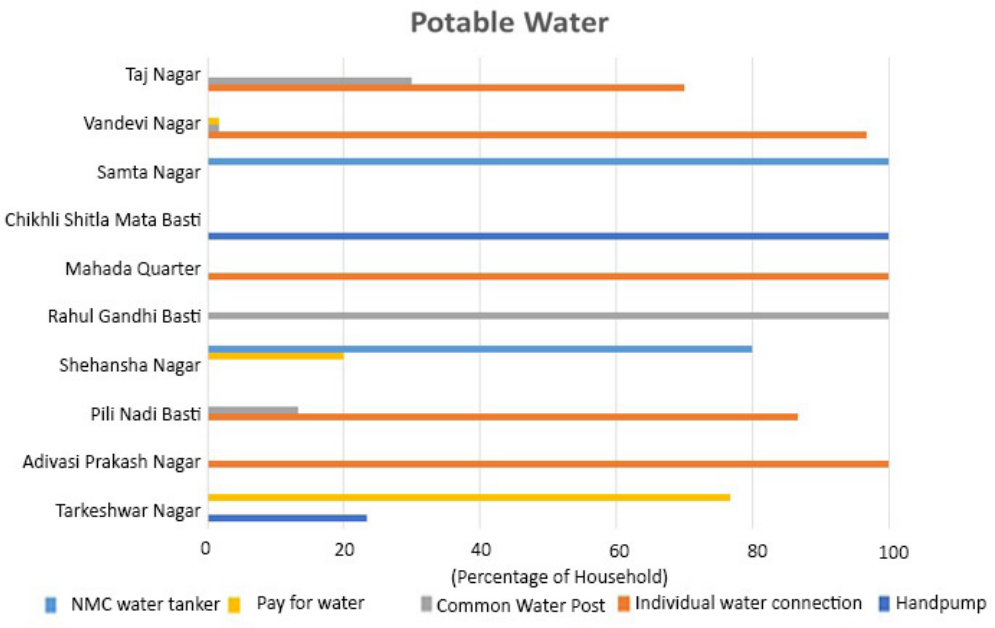
Pucca houses are made from more durable materials like bricks, concrete, and concrete slab. However, they sometimes lack proper sanitation facilities and access to clean water.
It's important to note that housing in slums varies widely based on legal recognition, location, and the duration of the settlement's existence. Additionally, efforts by governments such as schemes like Gharkul helps them to build pucca houses.

From the study, it was found that Mahada quarter was the most sustainable slum in terms of climate resilience as 100% houses were pucca houses. Adivasi Prakash Nagar and Pili Nadi basti also had 62% and 60% pucca houses. This is mainly because these slums are notified, and the residents maintain their houses due to better livelihood opportunities.

As many slums from study areas are non-notified slums, the community does not want to spend money on betterment of their housing infrastructure. They continue to live in dingy homes and spend money for repairs and maintenance every year.

3.3.2 Potable Water

From the FGD and primary visit to slums, some respondents talked about the challenges to get piped potable water.



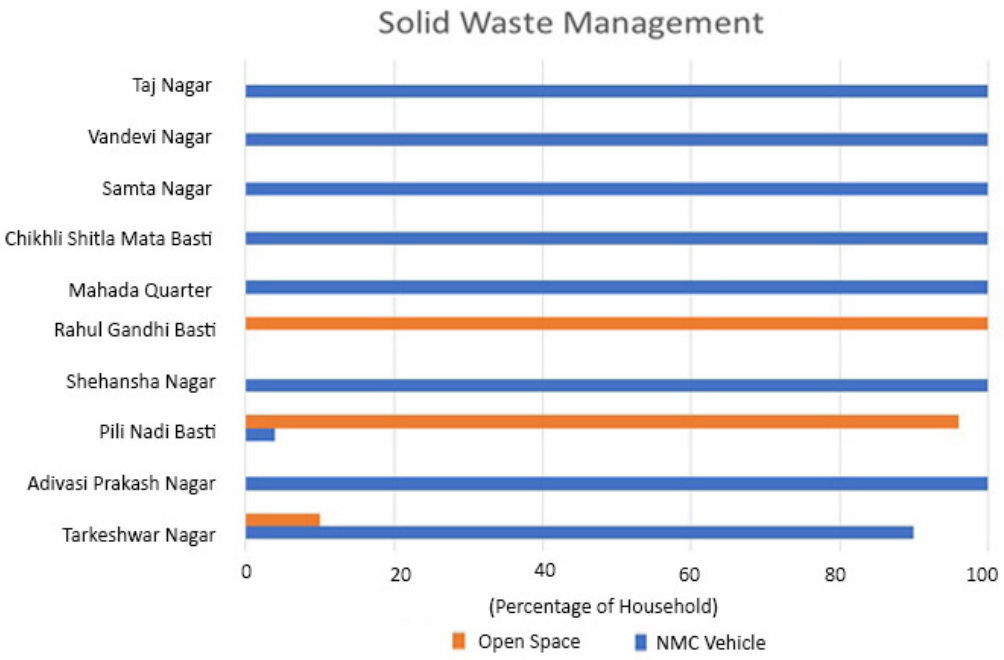
From the study it is seen that 80% community from Tarkeshwar Nagar face maximum challenges to get potable water from municipal corporation and have to pay for water tankers. 100% of the respondents from Samta Nagar does not have tap water connections but are lucky enough to get access to water supplied by water tankers of NMC. While 100% community respondents from Chikhli Shitla Mata Nagar have no access to piped water supply and rely on Borewell. 100% community from Rahul Gandhi Nagar has to rely on public water post (hand pumps).

Water connections and supply of water is dependent on the status of slums being notified or non-notified. Sometimes it is also dependent on the location - if the slums are out of the city boundaries, the water supply does not fall in the purview of the NMC. in such cases the community has to fend for themselves by buying expensive water.

Sometimes this water is contaminated that can give rise to health issues. Respondents using bore-wells also said that there have been few instances when they got polluted water. This clearly shows that in these densely populated slum communities, the absence of proper sewage systems and waste management infrastructure can lead to the contamination of water sources. The improper disposal of solid waste, and the absence of wastewater treatment facilities can result in pollutants and pathogens leaching into groundwater or surface water. As a result, the lack of sanitation services not only poses significant health risks to slum residents but also contributes to the pollution of water resources.

3.3.3 Solid Waste Management

During the primary visit to slums, it was noticed that solid waste management is a challenge in the slums. Especially because the waste collection vans come at the entrance of slums and inhabitants have to carry their waste - accessibility to the collection vans is the problem. The timings of collection are not fixed which makes it even more difficult to dispose the waste.



Bar diagram of waste management situation in slums

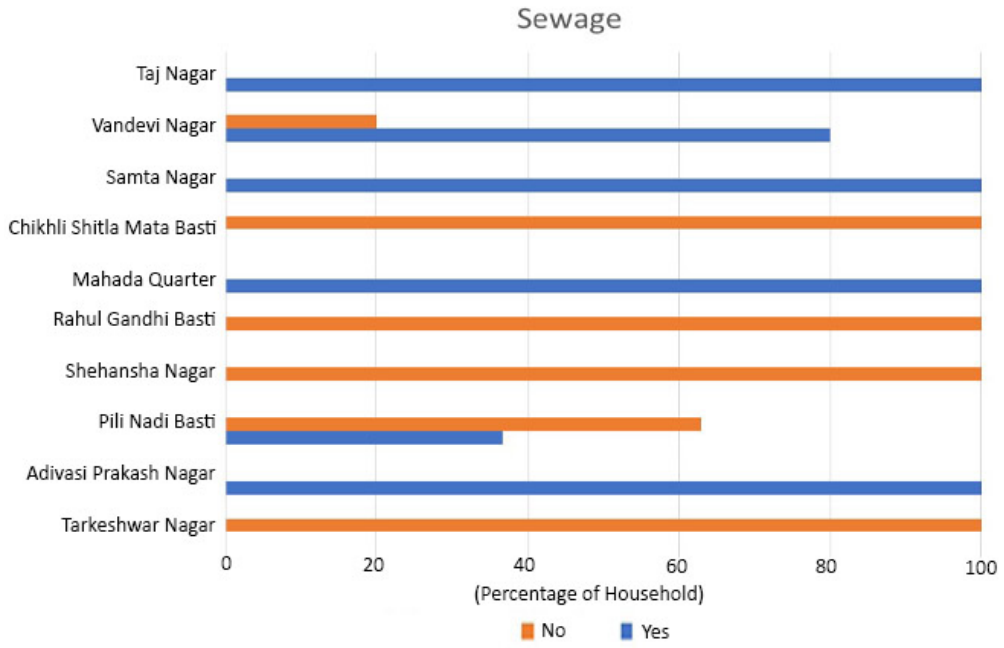
From the study it was found that 8 out of 10 slums responded saying that they have good solid waste management in the slums and NMC vans pick waste regularly. However, source segregation was not found in any slums.

In Rahul Gandhi Basti 100% respondents said they dispose of their waste either in open spaces or near water bodies as waste is not being picked from their slum by NMC. In Pili Nadi Basti 80% respondents dispose of their waste by the water stream near their slum.

The lack of proper waste management systems in slums can lead to the accumulation of solid waste, which, when combined with flooding, can block drainage systems and create breeding grounds for disease vectors like mosquitoes. Additionally, these slums, frequently located in flood-prone areas, are more susceptible to climate-related disasters, and the absence of sanitation infrastructure can worsen the destruction caused by floods. Addressing this critical issue not only improves public health but also enhances the overall climate resilience of marginalized populations by mitigating the associated risks with poor sanitation practices and inadequate infrastructure.

3.3.4 Sewage

During the FGD, most slums were seen having grey water runoff. This sector was added to the study to address the issues the community is facing.



Bar diagram of sewer network in slum

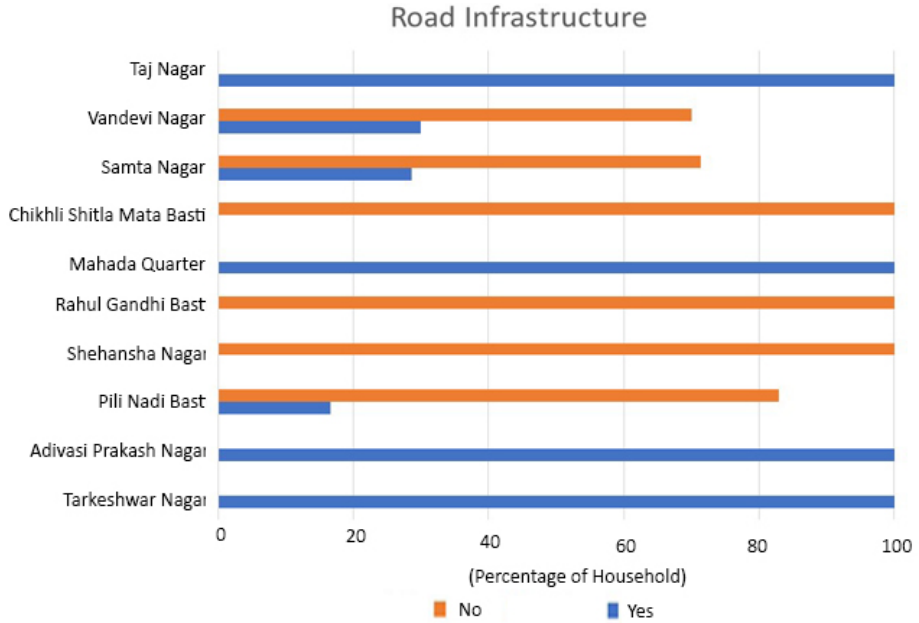
From the study it was found that 50% of surveyed slums did not have a proper sewage system. 100% respondents in Chikhli Shitla Mata Basti said they did not have a sewage network while 95% respondents in Shahenshah Nagar and Rahul Gandhi Basti said there was no drainage facility. The greywater runoff was found either in the slum itself giving rise to inundation of water in the houses, toilets or in nearby water sources like ponds or nallah. This is mainly because houses are not built at appropriate places.

Without a proper sewer network there is a chance of greywater contaminating the surface and groundwater sources. Contaminated water sources and exposure to human waste contribute to poor health conditions. This water if consumed can lead to the spread of waterborne diseases such as cholera, diarrhea, and typhoid. This contamination affects the slum residents especially in monsoon season.

Water logging and reverting back of sewer water in monsoon season are common problems of majority slums. It impacts their productivity, wellbeing and livelihood of the family.

3.3.5 Road Infrastructure

During the FGD, most slums did not have paved roads. Internal roads between streets were also missing.



Bar diagram of road availability in slums

From the study it was found that Rahul Gandhi Basti and Shehensha Nagar had no roads in the entire slum. While Chikhli basti has 5% approach road and Pili Nadi has 18% road.Vandevi Nagar and Samta Nagar have 25% and 45% road connectivity.

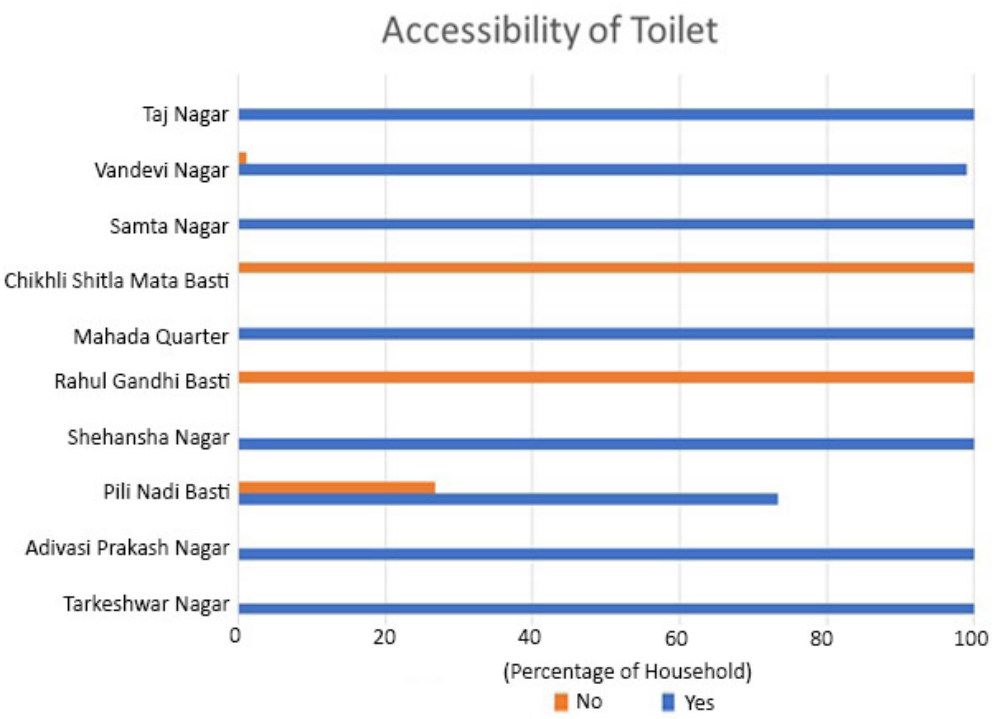
The absence of roads restricts residents' mobility, making it difficult for them to access job opportunities, schools, healthcare facilities, and other essential services. This limitation exacerbates the cycle of poverty and unemployment within slum communities. Slum dwellers who rely on small businesses, street vending, or daily wage labor often struggle to transport goods or access markets due to the absence of roads.

This further hinders their economic prospects and financial stability. Children face difficulties in commuting to schools which reduce access to education. This perpetuates the cycle of limited opportunities and low socio-economic status. Inadequate roads can hinder waste collection services, exacerbating sanitation issues in slums and contributing to health hazards.

Addressing this issue is not only a matter of infrastructure development but also a crucial step toward breaking the cycle of poverty, enhancing access to essential services, and improving the overall quality of life for slum dwellers. It requires a concerted effort involving local authorities, community participation, and strategic planning to ensure that road infrastructure becomes a catalyst for positive change.

3.3.6 Accessibility to toilets

During the FGD, it was found that few slums lacked individual toilets as they were non-notified. This aspect covers the access to toilets in slum communities.



Use of toilet in slums

From the study it was found that 100% of the communities of Chikhli Shitla Mata Basti and Rahul Gandhi Nagar had to use a shared/ common toilet. About 22% of respondents in Pili Nadi Basti also have to use common toilets. The respondents shared that cleanliness of common toilets is an issue and it is not cleaned daily. During monsoon, the water reverts from the toilets making it unusable and the community has to resort to open defecation. They said that water storage tanks for toilets are refilled every day.

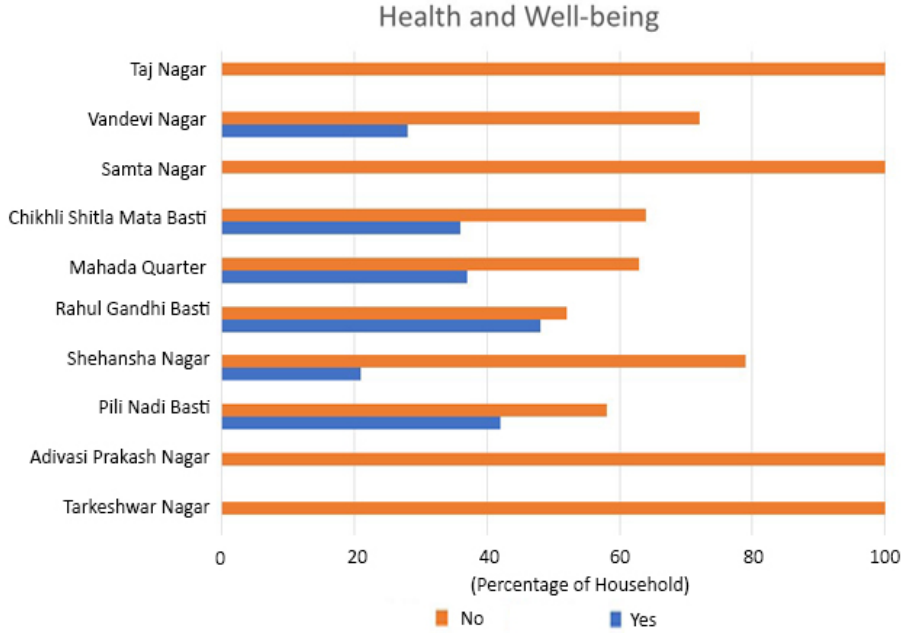
The absence of adequate toilet facilities in slum areas significantly contributes to climate vulnerability in multiple ways. Without proper sanitation infrastructure, slum dwellers often resort to open defecation that are prone to contamination and overflow during heavy rains. This contamination can affect nearby water sources, exacerbating the spread of waterborne diseases, particularly in regions already grappling with climate-induced flooding. Inadequate sanitation facilities also pose health risks, especially for children and the elderly who are more susceptible to waterborne illnesses.

Key recommendations:

Swachh Bharat Mission (Urban) provides improved sanitation facilities to urban areas, including slums. It includes the construction of community and public toilets to promote sanitation and hygiene and the objective of a defecation free city. This is the entitlement scheme the community can utilize once they are notified slums.

3.3.7 Health and Well-being

During the FDG, the women respondents shared their experience of health getting affected in various seasons. In the sample areas, most respondents said they felt uncomfortable during heat waves with instances of dizziness, low blood pressure and nausea. While in monsoon they faced viral fever, cold and skin problems. However, with open drainage and improper solid waste management, the presence of mosquitoes was felt. The issue of vector borne diseases was addressed in the study.



Although the respondents said yes to mosquitoes in their areas, very few of them accepted the presence of vector borne diseases. Most of the respondents were reminded of Chinkungunya in 2013 when the majority of the community was taken ill. However, 50% respondents in Rahul Gandhi Basti, 41% in Pili Nadi Basti, 38% Mahada Quarter and 37% in Chikhli Shitala Mata said their community was prone to yearlong vector borne diseases such as Dengue and Malaria.

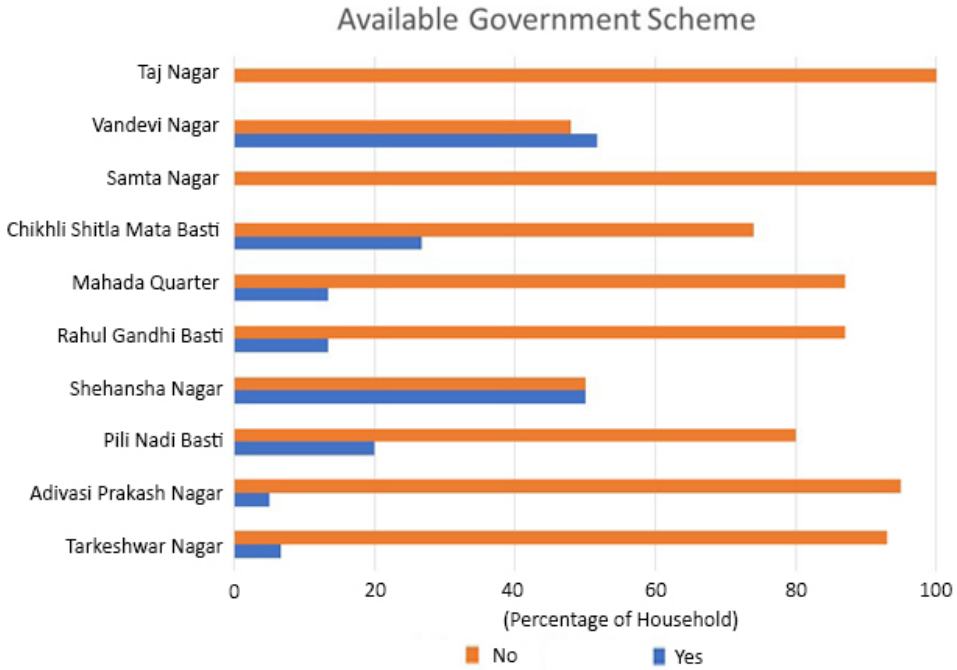
The slums of cities are the most vulnerable due to its unhygienic environment and high population density that requires an urgent implementation of public healthcare measures. A pandemic like COVID-19 has already hinted towards the need of urban resilience measures for better health.

Some factors associated with slums such as crowding, pollution, noise, inadequate lighting and lack of green space access, can exacerbate mental health disorders, including depression, anxiety, violence and other forms of social dysfunction. While among the adolescents and men, issues such as violence, deprivation, social vulnerability, substance abuse/use are also prevalent etc. There have been increasing concerns about women safety due to rising eve-teasing and assault cases as well as domestic violence.

Climate vulnerability leads to loss in income and livelihood that further aggravates mental health problems.

3.3.8 Available Urban Government Schemes

The effective utilization of available entitlement schemes and programs, whether offered by governments or non-governmental organizations, holds the key to improving the living conditions and overall well-being of slum residents. These schemes encompass a broad spectrum of essential services, including housing, healthcare, education, sanitation, livelihood opportunities, and more. Accessing these resources not only enhances the quality of life but also contributes to building resilience within slum communities.



Bar diagram for availed schemes by slum residents.

Central to harnessing the benefits of these schemes is maintaining open and consistent lines of communication with relevant authorities. This proactive engagement with government agencies and community-driven activities is pivotal in ensuring that slum

residents are well-informed about the schemes and the processes to avail themselves of these valuable resources.
However, it's essential to acknowledge that not all slum settlements may be equally aware of these schemes and how to access them. For instance, in Rahul Gandhi Basti and Samta Nagar, residents may lack information about these programs.
While there are many challenges in urban systems, there are available government schemes catering to the vulnerable population. This is not an exhaustive list of all the schemes but the schemes that are relevant to the current study.

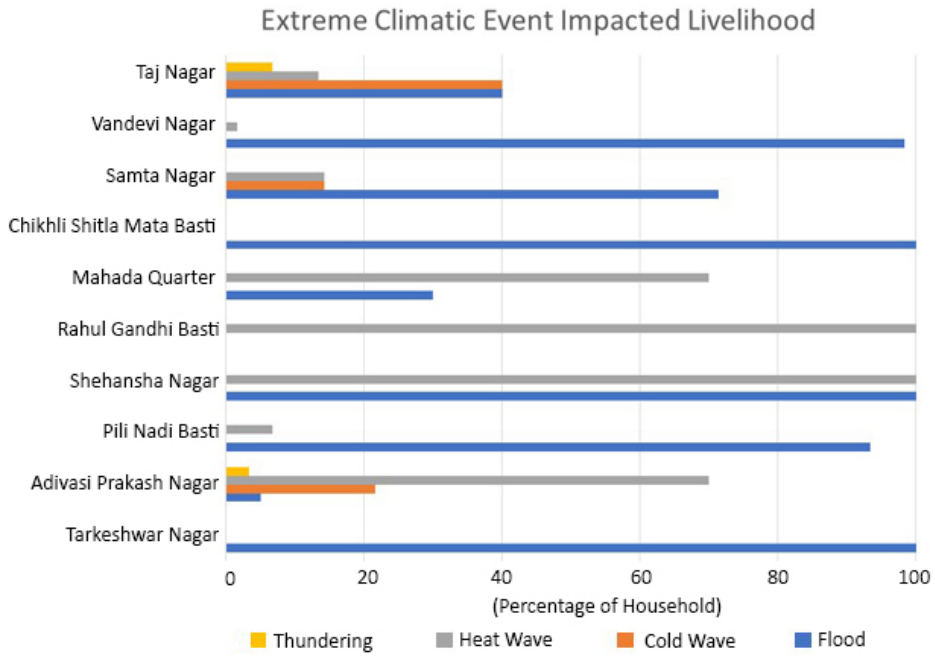
Social sector	Target group	Name of scheme	Details about the scheme
Health	Individuals from economically vulnerable backgrounds	Ayushman Bharat	Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (PM-JAY), commonly known as Ayushman card, is a government healthcare scheme in India that provides health insurance coverage to eligible beneficiaries.
	Families from economically disadvantaged backgrounds	Majhi Kanya Bhagyashree scheme	Initiative launched by the Maharashtra state government in India, the scheme aims to provide financial assistance and support to families with daughters

Social sector	Target group	Name of scheme	Details about the scheme
	Children, Pregnant women and lactating mothers	Integrated Child Development Service (ICDS)	Aimed at improving the health, nutrition, and development of children, as well as providing support to pregnant and lactating mothers. ICDS is implemented at the grassroots level, and its services are offered through Anganwadi centers across the country.
	Pregnant women and lactating mothers	Indira Gandhi MatritvaShayogYojna	aimed at providing financial assistance to pregnant and lactating women to support their health and nutrition during pregnancy and the first six months of their child's birth. The program is designed to improve the health and well-being of mothers and newborns, particularly those from economically disadvantaged backgrounds.
Education	Girls and Women	Beti Bachao Beti Padhao Scheme	Intended to address issues related to gender discrimination, female feticide, and the education of girls, the scheme reflects the government's commitment to ensuring the welfare and empowerment of girls and women in India.
Housing	Low-income communities	Swapna Niketan Awas Yojana, Nagpur	Launched by Nagpur Municipal Corporation's Slum Rehabilitation Authority, this scheme has come as a blessing for low-income groups. The project is a housing scheme providing subsidies and is launched under the Pradhan Mantri Awas Yojana mission.
	Low-income communities	Pradhan Mantri Awas Yojana (PMAY)	PMAY-U is a flagship housing scheme by the Government of India aimed at providing affordable housing to urban poor, including slum dwellers. It offers financial assistance to eligible beneficiaries for the construction or enhancement of houses
	Low-income communities	Integrated Housing and Slum Development Program (IHSDP)	This program focuses on the development of slum areas by providing infrastructure and housing facilities to improve the living conditions of slum residents. It may include the construction of pucca houses, community toilets, and other amenities
	Low-income communities	Jawaharlal Nehru National Urban Renewal Mission (JNNURM)	JNNURM aimed at improving infrastructure and services in urban areas, including slums. It supported projects related to housing, water supply, sanitation, and urban transport.
		Atal Mission for Rejuvenation and Urban Transformation	AMRUT Scheme is a development mission launched by the Prime Minister of India in 2015 with the focus to establish infrastructure that could ensure adequate robust sewage networks and water supply for urban transformation by implementing urban revival projects.
	Low-income communities	Maharashtra Slum Rehabilitation Scheme	A scheme by Maharashtra state government, it includes provisions for the redevelopment of slums, with the goal of providing better housing and amenities.

Social sector	Target group	Name of scheme	Details about the scheme
	Low-income communities	Swachh Bharat Mission (Urban)	This mission aims to provide improved sanitation facilities to urban areas, including slums. It includes the construction of community and public toilets to promote sanitation and hygiene.
Livelihood	Low-income communities	Deendayal Antyodaya Yojana - National Urban Livelihoods Mission (DAY-NULM)	DAY-NULM focuses on poverty reduction and livelihood promotion among the urban poor, including slum dwellers. It provides skill development training, self-employment opportunities, and access to credit.
	Low-income communities	Pradhan Mantri Jan Dhan Yojana	Jan Dhan Yojana is a financial inclusion program of the Government of India open to Indian citizens, that aims to expand affordable access to financial services such as bank accounts, remittances, credit, insurance and pensions.
	Low-income communities	E-shram Card	E-shram portal is a nationwide initiative by the Government of India aimed at providing social security benefits to unorganized sector workers, including laborers, construction workers, and others in various sectors. The E-shram card serves as a digital identity card for these workers, helping them access government benefits and schemes.

DISCUSSION AND CONCLUSION

It was concluded from this survey that some of the common income sources found in these 10 slums were Domestic worker, Labourer-casual (daily wagers), Street vendor/ shop/ business (Recycling and waste collection), Transportation services (Auto rickshaw driver, uber / old driver), Construction laborer and Salaried workers.
It's important to note that slum dwellers often face economic challenges due to lack of access to education, healthcare, and formal employment opportunities. Improving their economic circumstances requires a multifaceted approach that addresses issues such as housing, education and access to basic services. During the conduction of the survey, it was found that 17% of women are engaged in home-based work and rest of the women respondents raised the need of employment opportunities which primarily include home based work. They want to support their family and themselves through additional income.



Bar diagram of extreme climatic event impacted livelihood of slum residents.

The study concluded that the majority of urban poor from 10 slums of Nagpur are affected by the two major climate stresses which are flooding and heat waves. The impact of climate stress on their work is as follows:

Livelihood	Climate stress	Cause	Risk
Domestic worker /home based worker	Flooding	Waterlogging in houses and roads	Loss of working days
Labour-construction / Auto rickshaw driver		Stagnant water on surroundings, Improper water networks	Vector borne diseases
Casual labour / Salaried worker			Muddy drinking water
Shop / business/ street vendors		Inadequate and absence of sewer network	Overflowing of sewer water from toilets
			Loss of working days in monsoon
		Inadequate space for storage	Damage of stored household material (grains, bedding)
Domestic worker /home based worker	Heatwaves	Exposed themselves to work in high temperature	Health impacts such as heat strokes, dehydration, sunburn and skin damage, nausea, suffocation and heat related illness
Labour-construction / Auto rickshaw driver		Lack of proper ventilation	
Casual labour / Salaried worker		Heavy workload	
Shop / business/ street vendors		Material used for construction of houses includes asbestos sheet, metal sheet	Unsuitable indoor temperature
		Loss of working days	Lack of drinking water supply

From the study it can be concluded that in order to build resilience of the urban poor community these three aspects have to be strengthened. However, the emerging issues such as lightning and storms also need to be given importance.

Enhancing Housing Infrastructure

Inadequate housing leading to overcrowding in houses, quality-of housing and access to infrastructure stands as a fundamental pillar in mitigating the exacerbated effects of climatic stress. This entails fortifying the structural integrity of residences to withstand extreme climatic events, bolstering drainage systems to combat flooding, and advocating for the adoption of climate-resilient construction materials.

Facilitating Access to Basic Services

Ensuring the availability of clean water and the provision of sanitation facilities is pivotal in mitigating health hazards linked to contaminated water sources and substandard sanitation practices. Fostering clean and hygienic toilet facilities, slum level solid waste management, access to roads can significantly uplift the overall well-being of slum inhabitants.

One of the keys to resilience of urban poor slums is an integrated development approach called "reblocking," a process by which slum communities physically rearrange themselves to create new streets and public spaces that provide access to every residence, facilitating the introduction of modern services.

Delivering Healthcare

Securing accessible healthcare and plays an instrumental role in enhancing the resilience of slum communities. Adequate healthcare provisions can address health challenges that are exacerbated by climatic stressors, while education equips individuals with the knowledge and skills necessary to adapt to a changing climate.

Based on the study as well as the primary and secondary data available the following are some of the recommendations for building community-based resilience with low-cost solutions. The possible climate change resilience partnership and collaboration opportunities are enclosed in Annexure 3.

Design Friendly Housing

Slums face inadequate housing due to affordability. Many times homes are used as workplaces, especially by women. The location, construction, and energy consumption of homes are the important factors for climate change resilience. They need to be designed, built and operated in a way that anticipates, prepares for, and adapts to the changing climate conditions.

- For Heat, structural designs can help reduce heat inside buildings. Promoting low-cost housing upgrades can make a huge difference to housing. Weather-resistant roofing called Mod Roof Technology (1) uses sustainable materials. It consists of cardboard waste, coconut Fiber, sand and plastic waste for waterproofing. The resultant Mod Roof comprises bright turquoise-blue panels that are waterproof, durable, light and quick to install. The roofs are already installed in many slums of Ahmedabad, Bhopal, Jodhpur and Surat. (2)

- Application of white paints is the most low-cost recommended technology for slums. Known as "cool roofing", this process is designed to reduce the solar radiation absorbed, which in turn means less heat is transferred inside the building. White wash is a coating of lime wash which can cost as little as 1.5 rupees per sq. ft to more expensive reflective coatings or membranes. This reduces the temperature of the house by 2-5 degrees Celsius.

- Adding ventilation to existing structures using Airlite Ventilation is the best way to integrate into existing roofing structures. It improves ventilation and lighting. This solution uses a semi transparent corrugated unity made from fibre reinforced plastic sheet. The sheet material allows 70% light diffusion into the room. One such technology is Airlite Ventilation (3)

- Storms and lightning episodes are expected to become more frequent and stronger with climate change. They can affect houses in many ways, such as blowing off roofs and damaging the structures. To mitigate this damage, there needs to be a strong connection between foundations and the roof. Roofs should be of good quality and at the right slope and angle so that they can stand well in strong winds.

- For resilience in monsoon, housing needs preparation and repairs. To avoid water seepage through roofs, roofs need to be cleaned and repaired. Renovation of houses such as construction of "Brick Embankment" at the entrance of houses to avoid water inflow and repairing of weak walls is important.

- The houses also need a better drainage system for water evacuation and need raising of the plinth so as to avoid water seepage through the floor.

- Making sure that there are no small water puddles near the houses so as to avoid vector borne diseases.

01. https://www.engineeringforchange.org/solutions/product/modroof/ .
02. https://coolroofs.org/documents/2023-CRRC-Annual-Meeting-Charlotte-Steiner.pdf
03. https://selcofoundation.org/airlite-energy-efficiency/

- Community Based Flood Early Warning System (CBFEWS) is a system by which flood induced hazards can be minimized and prevented. The system is an ICT-enabled system to detect and respond to flood emergencies. It uses a flood sensor attached to the transmitter to detect rising water levels. When the water reaches a critical level, a signal is wirelessly transmitted to the receiver. The flood warning is then disseminated via mobile phones to appropriate agencies and vulnerable communities downstream. Critical flood levels are set with the help of local communities. System is developed by International Centre for Integrated Mountain Development (ICIMOD), Aranyak and Sustainable Eco Engineering (SEE) and in use in Assam.(1)

- Conduct climate awareness campaigns and workshops to educate communities about the impacts of climate change and how to better adapt their housing. Tools such as games can be utilized to better understand the concept in a fun way.

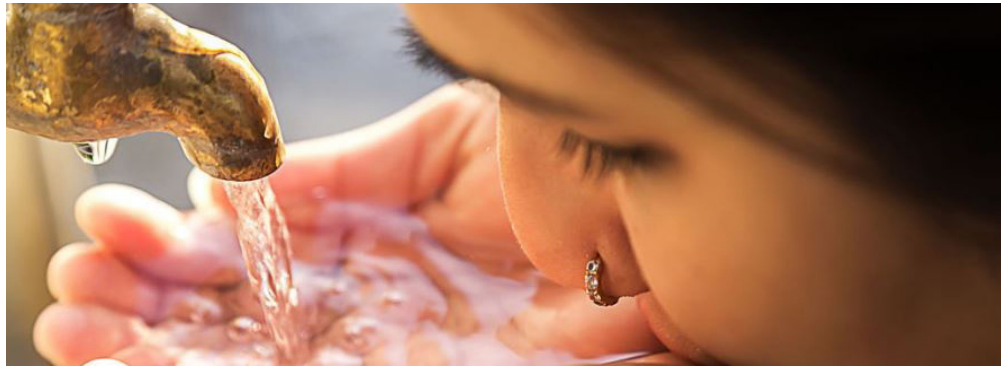
- Heat Resilient work spaces: Create shaded workspaces, distribute heat-protective clothing, and implement flexible working hours to reduce heat-related health risks for outdoor workers.

- Use of open places: Gardens can be opened up for hawkers and construction workers to rest during afternoon hours.

01. https://unfccc.int/climate-action/un-global-climate-action-awards/winning-projects/activity-database/community-based-flood-early-warning-system-india

Potable Water

Access to piped Municipal supply of clean drinking water can support women empowerment and safety in urban slums where women are typically responsible for collecting water from water tankers.



Solid Waste Management

It is important to strengthen waste segregation at source by education and training and prohibit dumping in open drains, open spaces, local ponds, canals and rivers that clog stormwater drains leading to water inundation and flooding. Burning the plastic and paper waste is also not the right way to dispose of inorganic waste. Leaving the food outside their home for dogs and cows to eat leads to rotting of food that may give rise to flies and the issue of scattered cow dung in the slums.

The community needs to understand the importance of not disposing waste near their household as it would lead to health complications, flooding in their homes and vector borne diseases. Training them about composting and urban farming can also be explored.

The community can also be trained about setting up informal recycling cottage industries from their homes and they can sell the inorganic waste to authorized recyclers. This will help generate a good chunk of income for the household.

Sewage and stormwater drainage management

Since a large part of wastewater is discharged onto the slum roads, it leads to the contamination of the storm water drainages and the groundwater aquifers. The recommended action here is to check the discharge of untreated wastewater from septic tanks directly into local water bodies.

It is recommended that NMC checks frequently for infrastructural gaps (recharge pits and septic tanks) leading to inundation of water in slums.

Health

Cleaner and more efficient home cooking, ventilation, and lighting systems can yield the largest health benefits to the poorest and most vulnerable sectors of society, including children, women and the elderly. It is highly recommended to check for water storage which could potentially be breeding grounds for vector borne diseases. Keeping the interior and exterior of the house clean is extremely important.

Community members are recommended to get health check-ups done at government hospitals so they are aware of lifestyle related diseases such as blood-pressure diabetes and mental health related disorders which can get aggravated during a climate calamity.

Community should seek medical help when they suffer from heat related effects like headaches, high blood pressure, nausea, skin diseases, nervousness, etc. Drinking clean drinking water, lemonades and buttermilk can give a lot of relief.

Way Forward

Nagpur is one of the few cities in India who has proactively made efforts towards climate resilient actions with the preparation of Nagpur Heat Action Plan and Climate Resilient City Action Plan. This study compliments the plan to build resilience of low income communities, by giving recommendations that have been given in this study.

To achieve a system exchange, the local and state government needs to strengthen the way they currently enable action in urban areas to build resilience by engaging with urban poor communities, undertaking risk-informed urban planning, and delivering adaptive social protection. They should support resilient livelihoods, deliver health services, address the exposure and vulnerability of housing and shelter, and ensure the integration of community - led infrastructure in city-level systems.

Nagpur is among the pioneering Indian cities to undertake climate actions locally. In order to address the climate stresses faced by the urban poor, it is important to have a dedicated climate change cell within the municipal corporation and its dedicated functions and funds for implementing short, medium and long-term climate resilience and policies related to it.

National and International partnerships also play an important role in implementing local policies. Not only do they bring in knowledge but also the funding required for this commitment.
The slum community needs awareness programmes about the existing Government schemes that they are entitled to and how they can take advantage of it.

CASE STUDY

Lakshmibai Mohanlal Taram, Samta Nagar

Lakshmibai has 3 sons, 2 of them who live away from her and one son who is studying in school and is dependent on her. Having lost her husband a few years back, she is the sole breadwinner of the family. She works as a daily wager.

She shared that heat months are especially difficult for her as she undergoes health issues which makes her work uncomfortable and adds medical expense. During the heat months, she suffers from anxiety, high BP, muscle cramps and skin itching.

She tried to relieve the heat stress by drinking lemonade but in extreme cases had to get hospitalized and put on saline drip. This gives her relief for a few days but as the heat increases, she suffers the same symptoms again.

In spite of these economic challenges when a technological intervention was suggested, she was ready to invest some amount for her thermal comfort.

Urmila Sahu, Samta Nagar

Urmila Sahu, lives with her son and husband. She sells vegetables every day and her son works as a painter on daily wages. Their daily income is approximately INR 300/-. In spite of this income, she hasn't been able to afford the electricity for the last 2 years and lives in a dark tin-shed house.

Her house faces flooding problems in monsoon as the monsoon water combining with grey water from a nearby nallah enters her house. Due to no upkeep of the tin shed, the rainwater enters from the roof and she relies on utensils to trap the water.

The entire slum has a problem of no tap water, no roads and no gutter line. This makes her living condition worse.

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